Stop 9 – Sromowce – Upper Cretaceous *Scaglia Rossa* with clastics (Figs 40, 41)

(*Michał Krobicki, Jan Golonka*)

One of the major attraction of the PKB region is the rafting through the Dunajec River Gorge (Golonka & Krobicki, 2007; see also Alexandrowicz & Alexandrowicz, 2004). The rafting trip on the Dunajec River, which starts at Sromowce Kąty harbour, takes geotourist through the Dunajec Gorge to Szczawnica. The Dunajec offers magnificent view of the cliffs sculptured in the Pieniny Mountains by the tectonic activity and river's erosion. It offers also the close view of the outcrops of Jurassic and Cretaceous rocks of the Pieniny Succession and complex tectonics of the PKB.

Strongly folded Jurassic-Cretaceous strata are visible along the road from Sromowce Wyżne to Sromowce Niżne, close to the Dunajec River, on the southern slope of Mt. Macelowa, where the Pieniny Succession rocks lie in an overturned position.

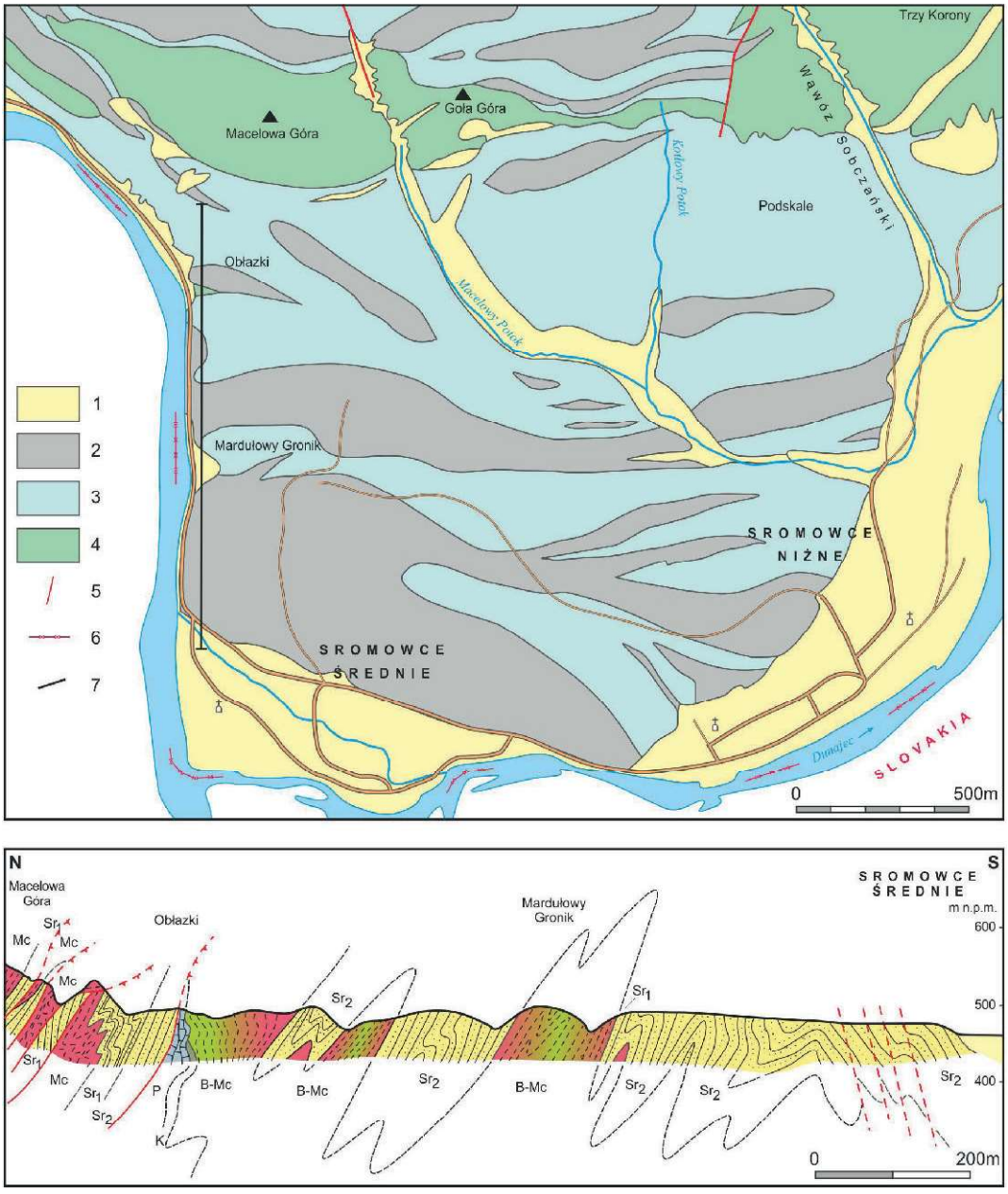

Fig. 40. Geological map of the vicinity of Sromowce (after Horwitz, 1963; Birkenmajer & Jednorowska, 1984, simplified) and geological cross-section: 1 – Quaternary; 2 – Sromowce Formation; 3 – Jaworki Formation, partly Kapuśnica Formation; 4 – Pieniny Limestone Formation, partly also Czajakowa Radiolarite Formation; 5 – faults; 6 – state border; 7 – geological cross-section (below); P – Pieniny Limestone Formation (grey cherty limestones); K – Kapuśnica Formation (green spotty marls); B-Mc – Jaworki Formation (Brynczkowa, Skalski and Macelowa Marl members – green, variegated and red marls respectively); Sr – Sromowce Formation (Sr1 – Osice Siltstone Member; Sr2 – flysch) (after Golonka *et al*., 2018)

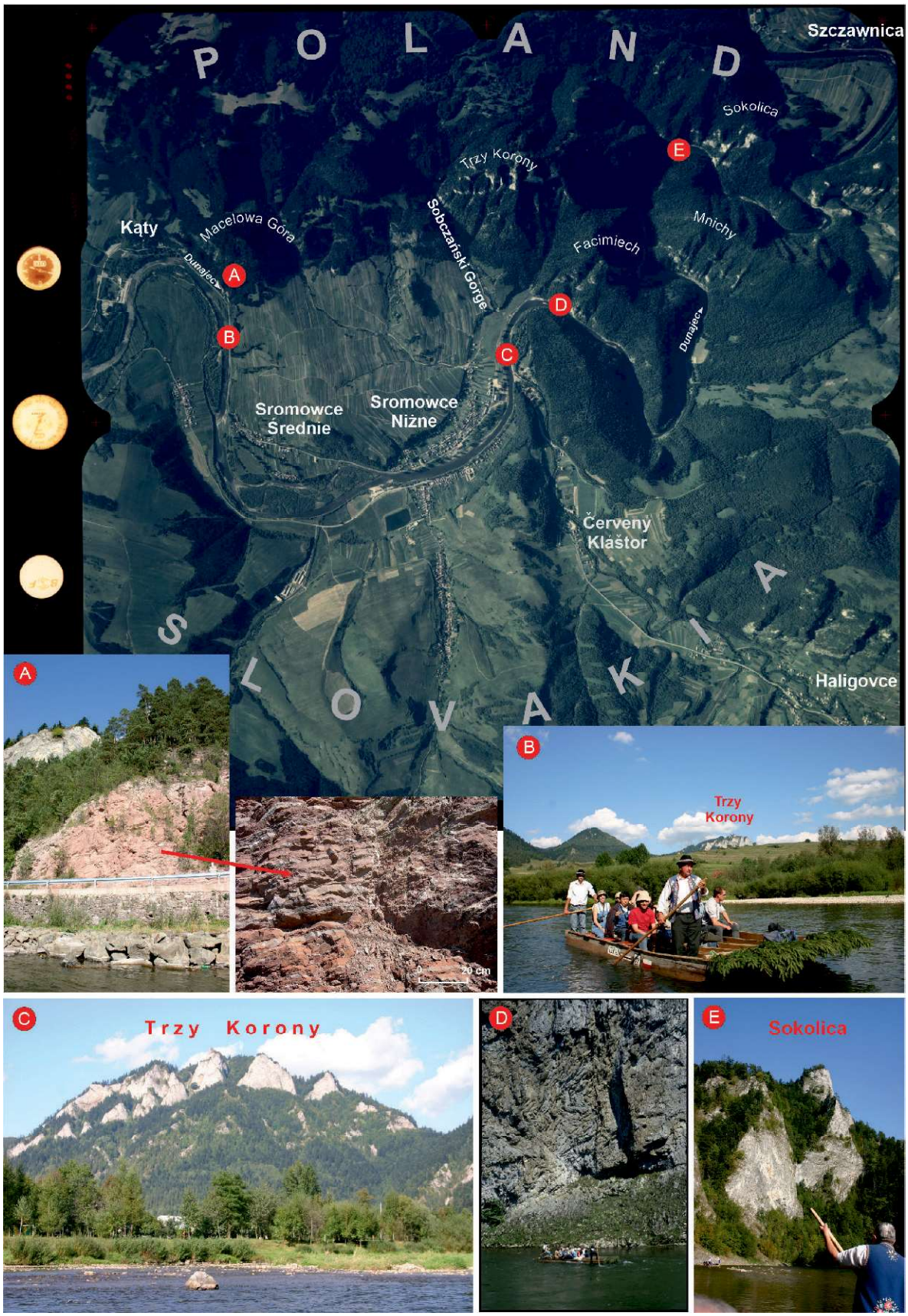

Fig. 41. Aerial view of the central Pieniny Mts. and Dunajec River Gorge with points of photos: A – Upper Cretaceous red marls of the *Scaglia Rossa*-type facies of the Macelowa Marl Member of the Jaworki Formation (Macelowa Mt.); B – close to beginning of the rafting in Sromowce-Kąty harbor in the Pieniny Mts., boat full of tourists; C, D – Trzy Korony Mountain built of *Maiolica*-type well-bedded cherty limestones of the Pieniny Limestone Formation, usually strongly tectonically folded; E – Sokolica Mt. over the Dunajec River Gorge (after Krobicki & Golonka, 2008)

The oldest Oxfordian radiolarites occupy the topmost part of Mt. Macelowa (on its northern slope), gray cherty limestones of the *Maiolica* facies (Pieniny Limestone Formation) occupy the transitional position and in the lowest (topographically) position are the Late Cretaceous *Globotruncana*-bearing marls of the *Scaglia Rossa*-type (Birkenmajer, 1977; Bąk K., 1998, 2000). Figure 15 depicts the Birkenmajer & Jednorowska (1987a, 1987b) ideas about the Cretaceous lithostratigraphy of the Pieniny Mountains. Red marls and marly limestones of pelagic deposits with grayish intercalations of calcareous sandstones and siltstones of distal turbiditic origin predominate in this outcrop. This is the youngest part of the multicolored (green-variegated-red) globotruncanid marls of the so-called Macelowa Marl Member of the Jaworki Formation, with good foraminiferal Upper Cretaceous biozonation (*Dicarinella concavata – D. asymmetrica* foraminiferal zones of the Upper Coniacian-Santonian) (Bąk K., 1998, 2000). These deposits originated during the final episode of the evolution of the PKB, when the unification of sedimentary facies took place within all the successions. Widespread in the Late Cretaceous Tethyan Ocean, the *Scaglia Rossa*-type facies (= *Couches Rouge* = *Capas Rojas*) represented by the Jaworki Formation – which were widespread in the Late Cretaceous Tethyan Ocean – indicates open connections throughout the Northern Tethys.

Stop 10 – Haligovce/Lipnik – Paleocene reefs after C/P mass extinction event (Fig. 42)

(*Michał Krobicki, Jan Golonka*)

In the vicinity of the villages of Haligovce and Lipnik, within the Paleogene flysch, there are large blocks of Paleocene olistolithic limestones, the oldest deposits of the so-called of the Pieniny Paleogene (Scheibner, 1968; Potfaj, 2002; Krobicki *et al*., 2004; Buček & Köhler, 2017). Their palaeontological and microfacial analysis showed the presence of numerous corals, red algae and foraminifera as well as bryozoans, serpulids, fragments of bivalves, brachiopods, echinoderms, sponges, and sporadically sponge spicules. Analysis of small fragments of coral colonies revealed the presence of scleractinians (*Asirocoenia*, ?*Acropora*, *Goniopora*, *Actinacis*, *Rhizangia*, *Orbignygyra*, *Favites*, *Oculina*, and ?*Rabdophylliopsis*) (Krobicki *et al*., 2004). Corals are often coated by the red algae Corallinaecae (the most numerous) and Peyssonneliaceae (*Polystrata alba*), with detritus being the most common in the carbonate matrix. Foraminifera are represented by large forms of encrusting agglutinating foraminifera (e.g. *Haddonia* sp.) and calcarous. General taxonomic composition of the corals most closely resemble the Paleocene corals from Slovenia. According to the palaeogeographic evolution of this area in the Paleocene time, the PKB was closed as a result of the collision of the Central Carpathians terrains with the Czorsztyn Ridge (Birkenmajer, 1986, 1988). The terrains of Adria, the Eastern Alps and the Inner Carpathians continued their movement northward. The Paleocene subsidence of the Magura Basin was associated with the shift of the subduction zone north of the Czorsztyn Ridge. In the Paleocene, the Alcapa superterrain was formed by combining the blanks of the Eastern Alps, the Tisza, the Inner Carpathians and other small terrains. At the same time, the aforementioned Paleocene reefs (Mišík & Zelman, 1959; Andrusov, 1969; Scheibner, 1968; Samuel *et al*., 1972; Köhler *et al*., 1993; Buček & Köhler, 2017) were formed in the shallowest zones of the basin, today's isolated occurrences of which can be found from the Eastern Alps (near Kambühel near Ternitz in Austria, the stratotype of the so-called Kambühel limestones, Tollmann, 1976; Faupl *et al*., 1987; Tragelehn, 1996; Müller, 2004) through western Slovakia (Mišík & Zelman, 1959; Scheibner, 1968; Köhler *et al*., 1993) to vicinity of Haligovce (Scheibner, 1968; Potfaj, 2002; Krobicki *et al*., 2004; Buček & Köhler, 2017). Identical limestones have also been found to be exotic within the boundaries of the Strihov and Proč strata of Western Slovakia (Mišík *et al*., 1991a, 1991b).

Stop 11 – Czorsztyn Castle (Jurassic-Cretaceous deposits of the Czorsztyn Succession) (Fig. 43)

(*Michał Krobicki*)

The Czorsztyn Castle klippen are one of the most famous geological site of the PKB with full sequence of Czorsztyn Succession from the Middle Jurassic up to Upper Cretaceous deposits, rich in invertebrate fossils such as: ammonites, brachiopods, crinoids, calpionellids, foraminifers, described and illustrated by numerous authors since beginning of the XIX century (e.g., S. Staszic, L. Zejszner, E. Suess, M. Neumayr, K. A. Zittel, V. Uhlig and others) (Uhlig, 1890a; Birkenmajer, 1963, 1977, 1979, 1983; Barczyk, 1972a, 1972b; Głuchowski, 1987; Krobicki, 1994, 1996b; Wierzbowski & Remane, 1992; Wierzbowski *et al*., 1999). Unfortunately, the water of present Czorsztyn lake covered the great part of this sequence (lowermost – lower part of the Middle Jurassic and upper part – Upper Cretaceous) and only Bajocian-Berriasian interval is available to study (partly by means of boat).